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Main

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[45] **Date of Patent: Feb. 20, 1996**

[54] **ROTARY VALVE CONTROLLED APPARATUS FOR STRIPPING CANS FROM BODYMAKING RAM**

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[73] Assignee: **Sequa Corporation**, Hackensack, N.J.

[21] Appl. No.: **236,466**

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[51] **Int. Cl.**[6] **B21D 45/08**

[52] **U.S. Cl.** **72/345**; 251/304

[58] **Field of Search** 72/345; 251/304; 137/625.21

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,509,163	9/1924	Minge	251/304
2,578,160	12/1951	Van Der Werff	251/85
2,593,733	4/1952	Davies	251/105
2,964,061	12/1960	Rawson et al.	137/627
2,994,344	8/1961	Kerley	251/304
2,996,083	8/1961	Huska	137/625.11
3,040,777	6/1962	Carson et al.	137/625.15
3,131,605	5/1964	La Borde	91/198
3,198,004	8/1965	Roberts et al.	73/45.1
3,635,069	1/1972	Eickenhorst	72/345
3,713,462	1/1973	Bushee	137/625.21
4,007,620	2/1977	Urban	72/345
4,316,707	2/1982	Hansen et al.	418/60
4,509,555	4/1985	Stirbis	137/625.11
5,183,145	2/1993	Williams et al.	198/441

Primary Examiner—Lowell A. Larson
Attorney, Agent, or Firm—Mitchell D. Bittman; Jerome M. Berliner

[57] **ABSTRACT**

A press for forming the relatively long cylindrical body of a so-called two piece beverage can utilizes a horizontally reciprocating ram to drive a relatively short cup through a circular die pack. Compressed air applied through a rotary valve is utilized to strip the bodies from the ram. Such valve includes a continuously rotating rotor that is mechanically connected to the drive for the ram such that for each rotor revolution the ram moves through a complete cycle consisting of a forward working stroke followed by a rearward return stroke. The rotor is constructed of two disks that abut face to face. A rotor drive shaft extends through the center of the rotor and the angular position of the disks relative to each other is adjustable to adjust the portion of each rotor revolution during which compressed air is applied for stripping. Each disk is provided with an arcuate aperture and the extent to which these apertures overlap determines how long compressed air is applied for stripping. The angular position of the rotor on the drive shaft determines when compressed air is applied for stripping.

14 Claims, 5 Drawing Sheets

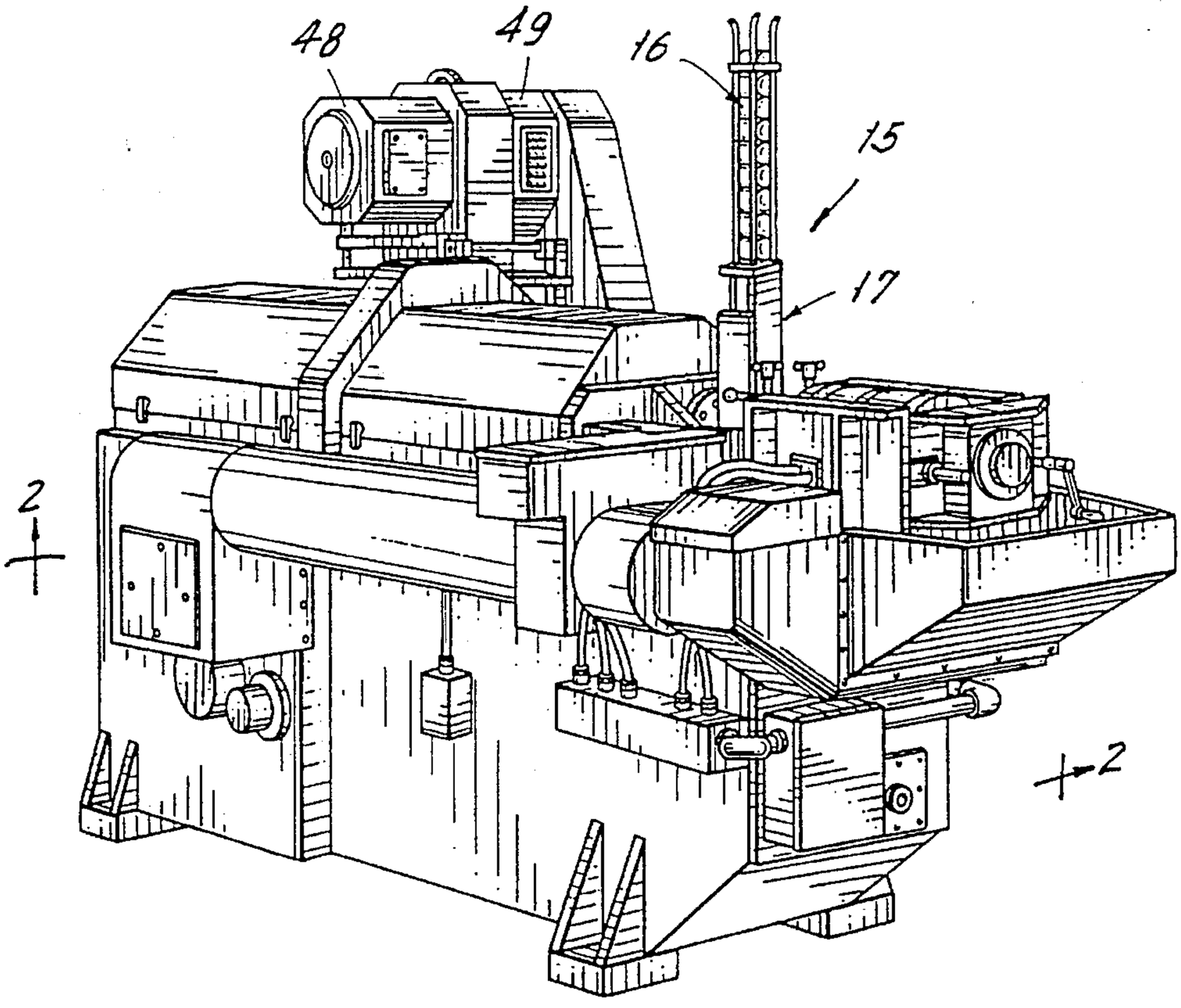


Fig. 1.

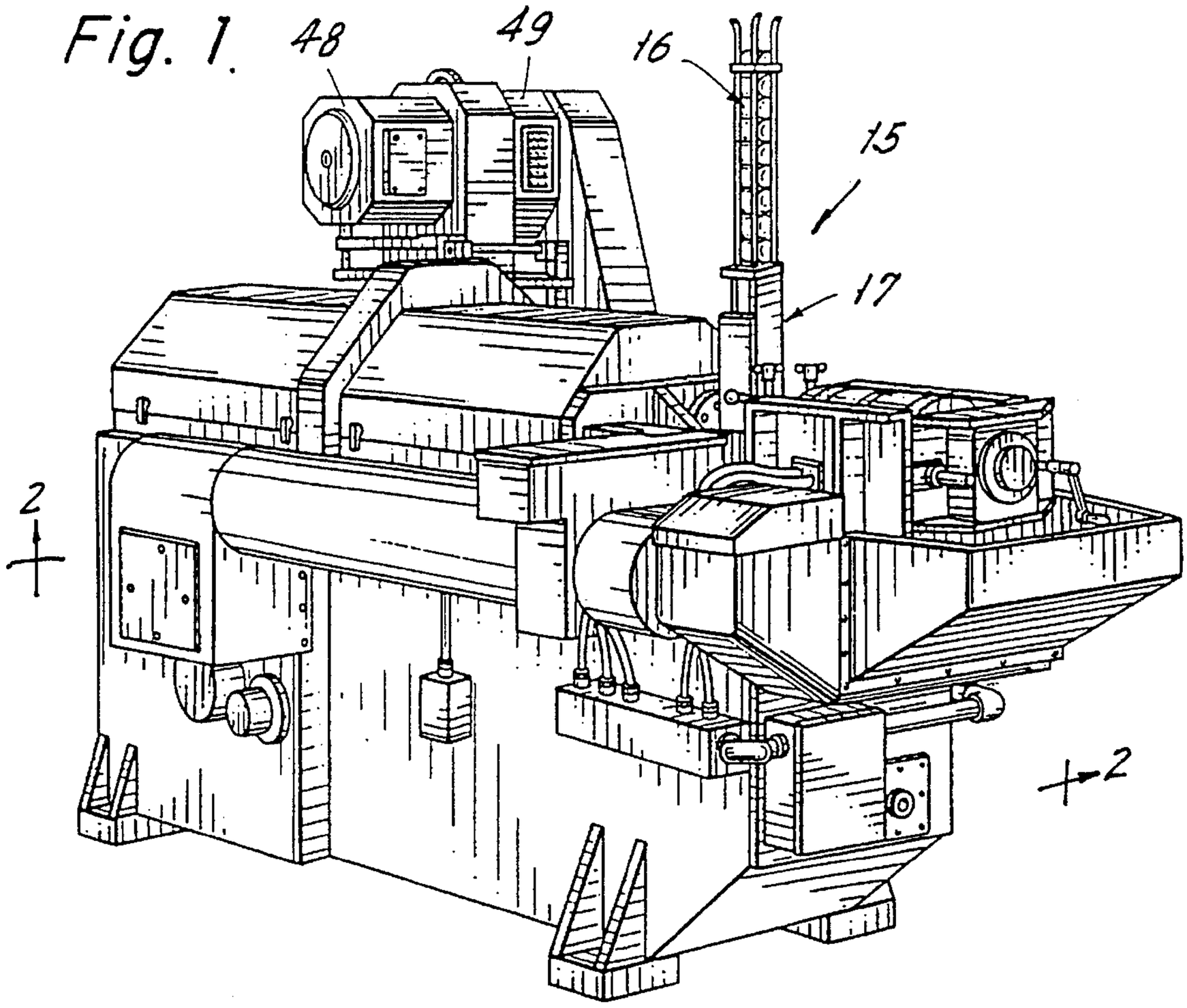


Fig. 4.

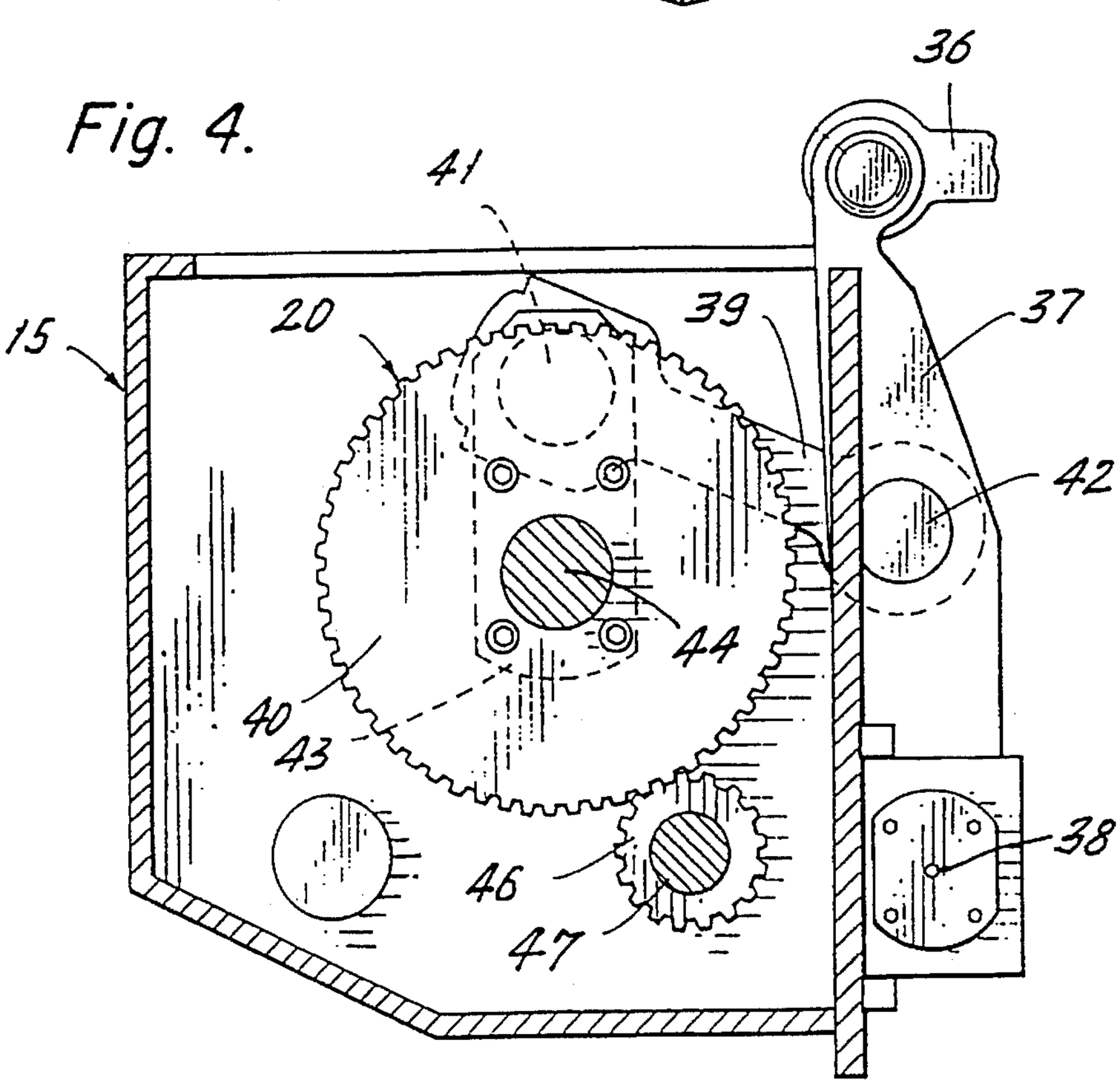


Fig. 2.

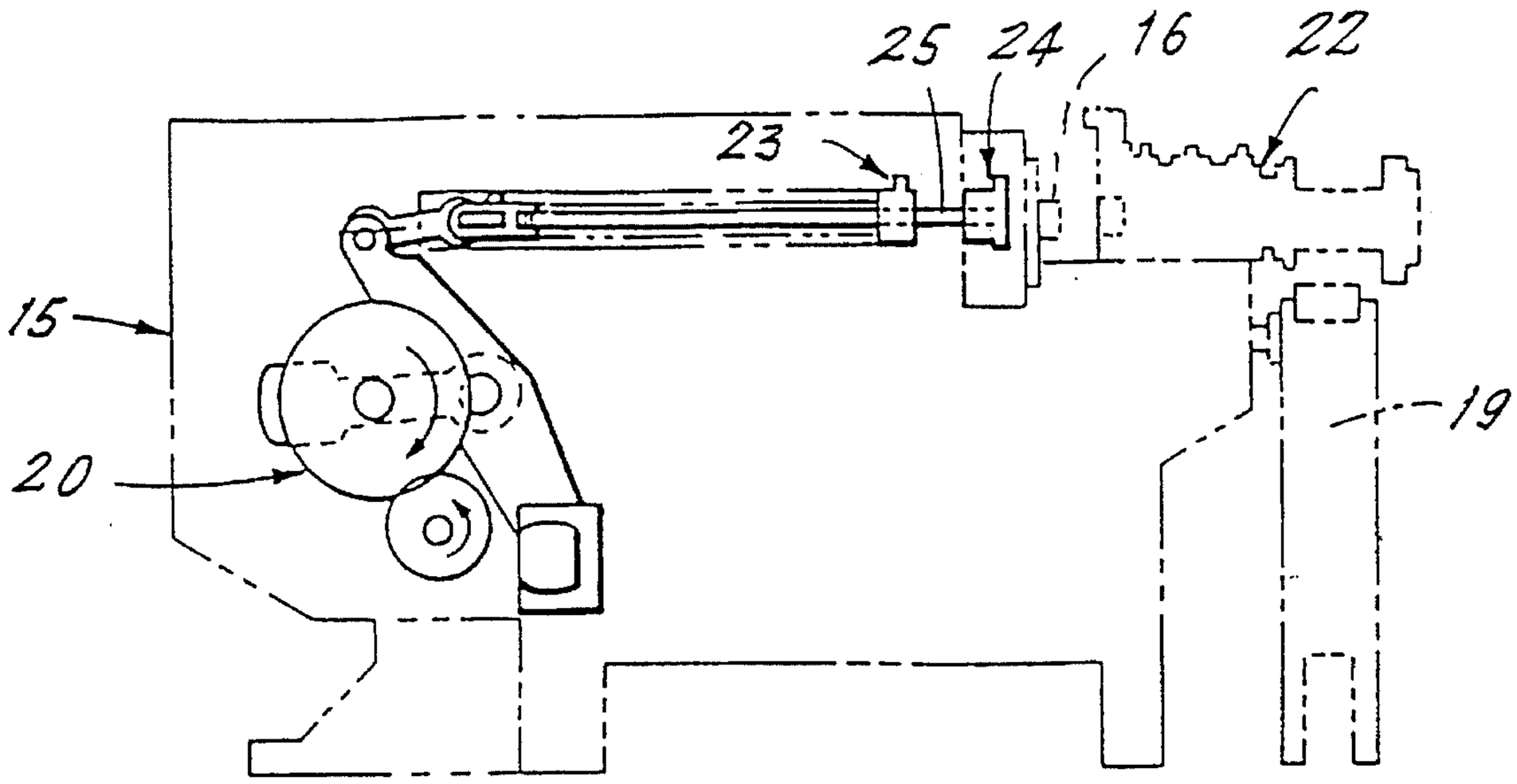
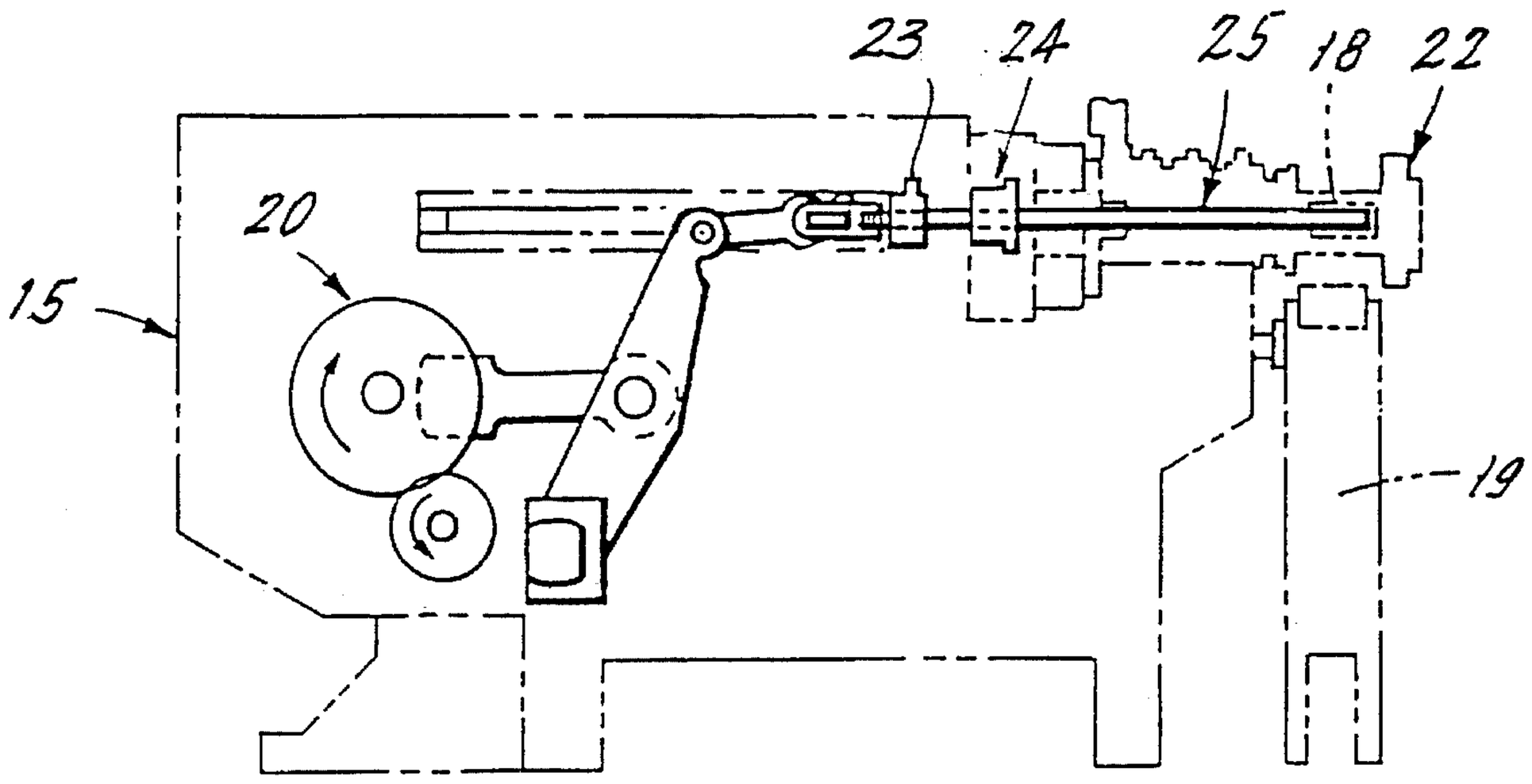


Fig. 3.



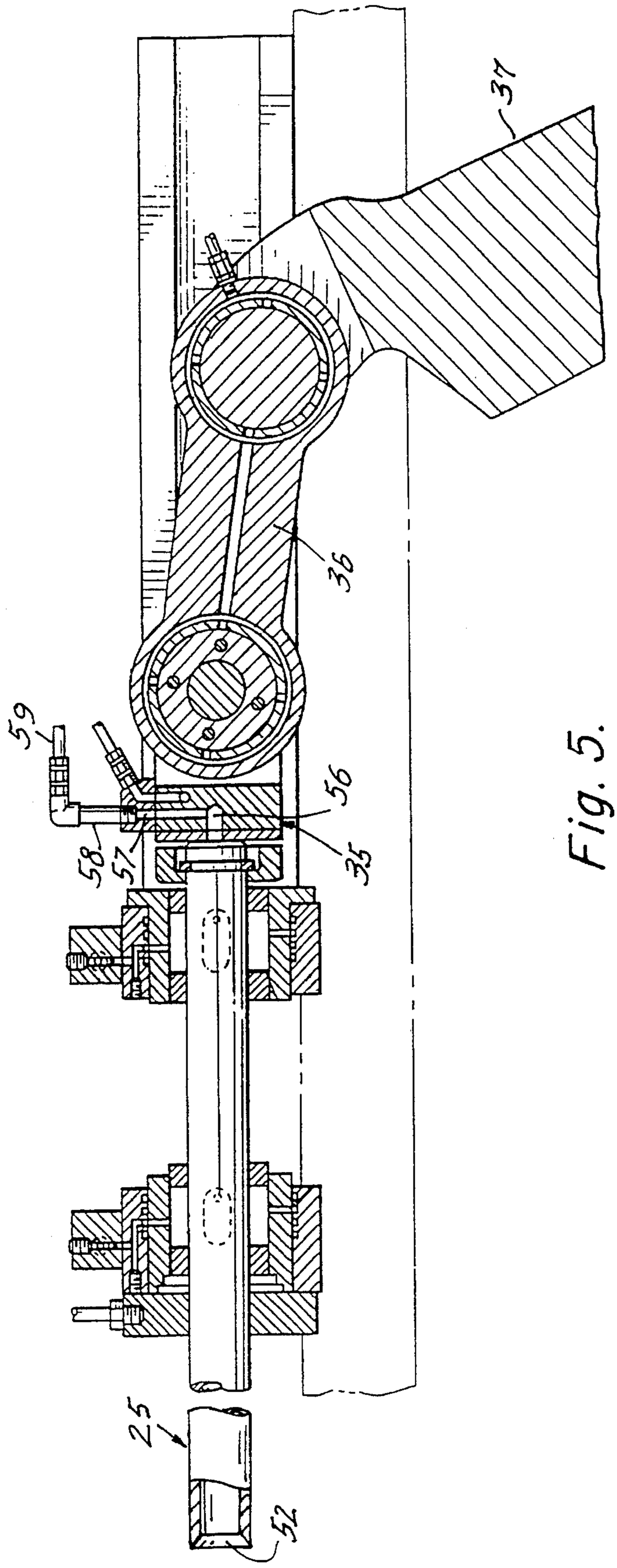


Fig. 5.

Fig. 6.

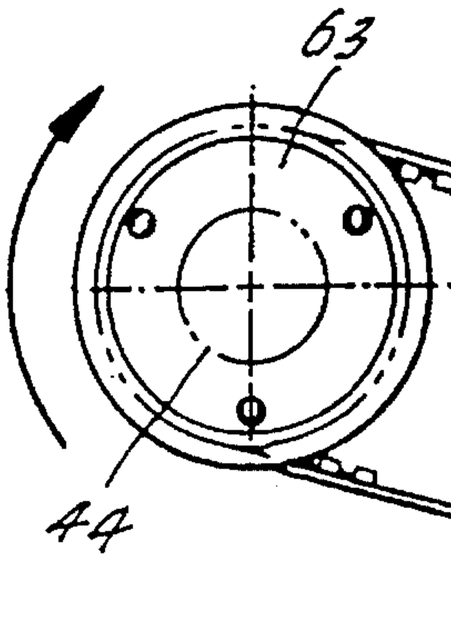
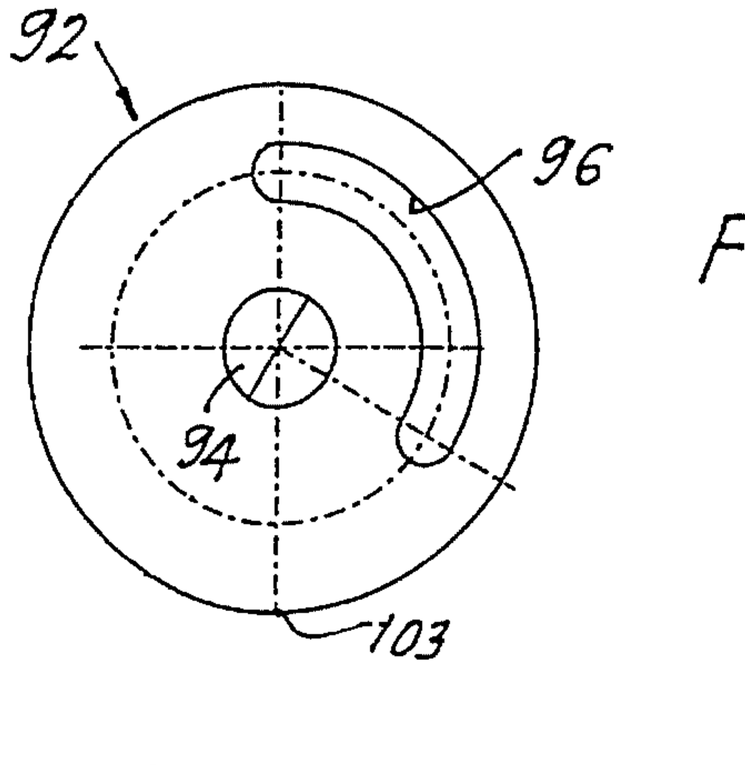


Fig. 10.



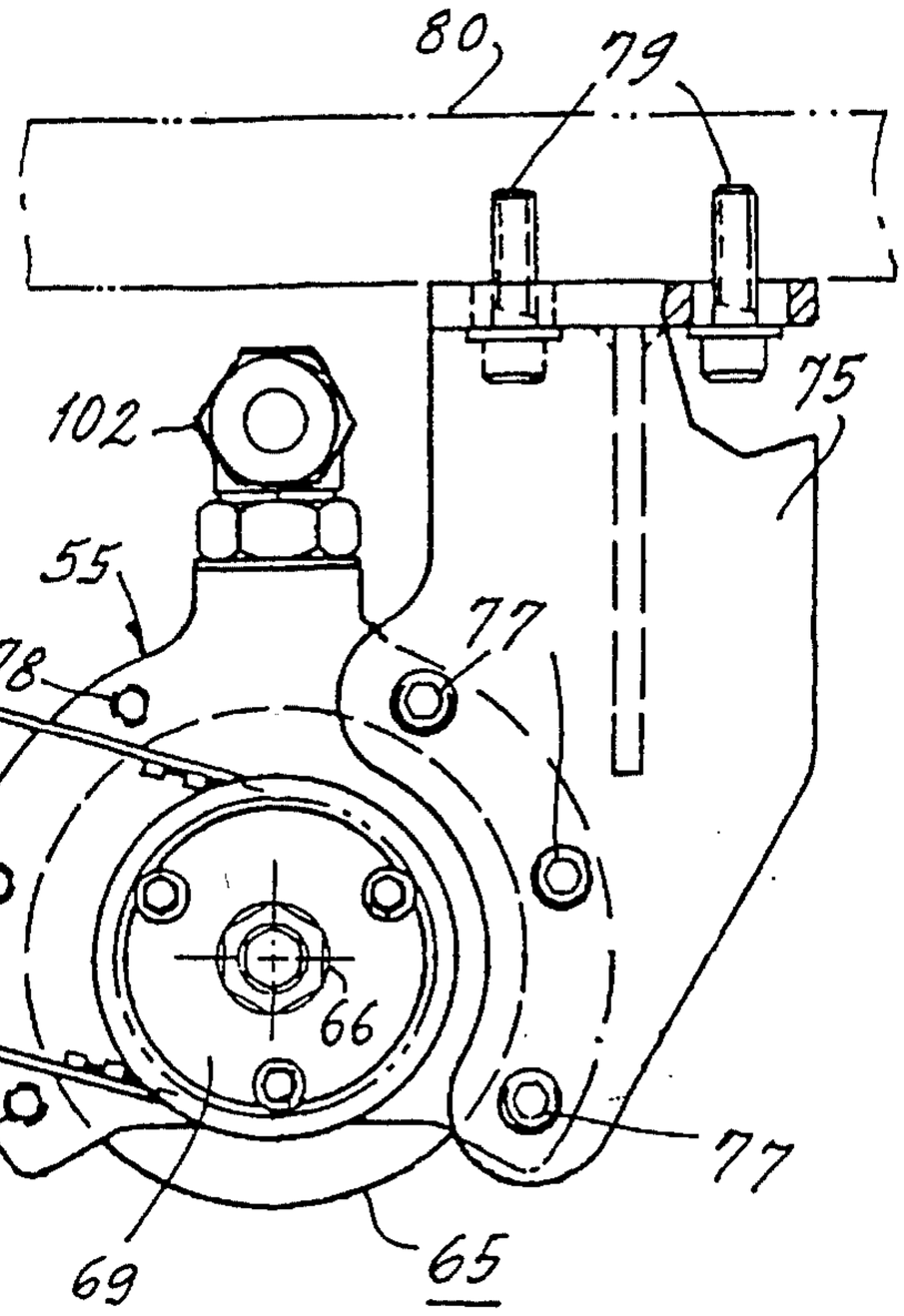


Fig. 11.

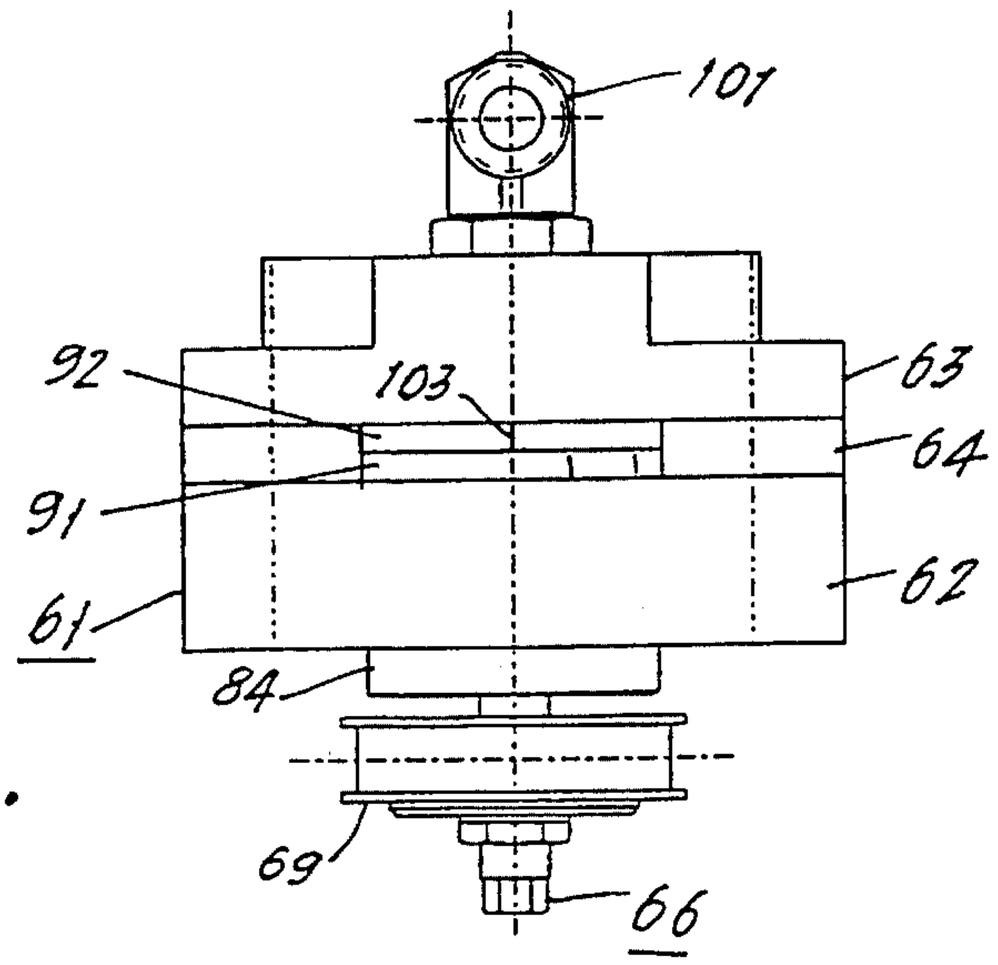


Fig. 9.

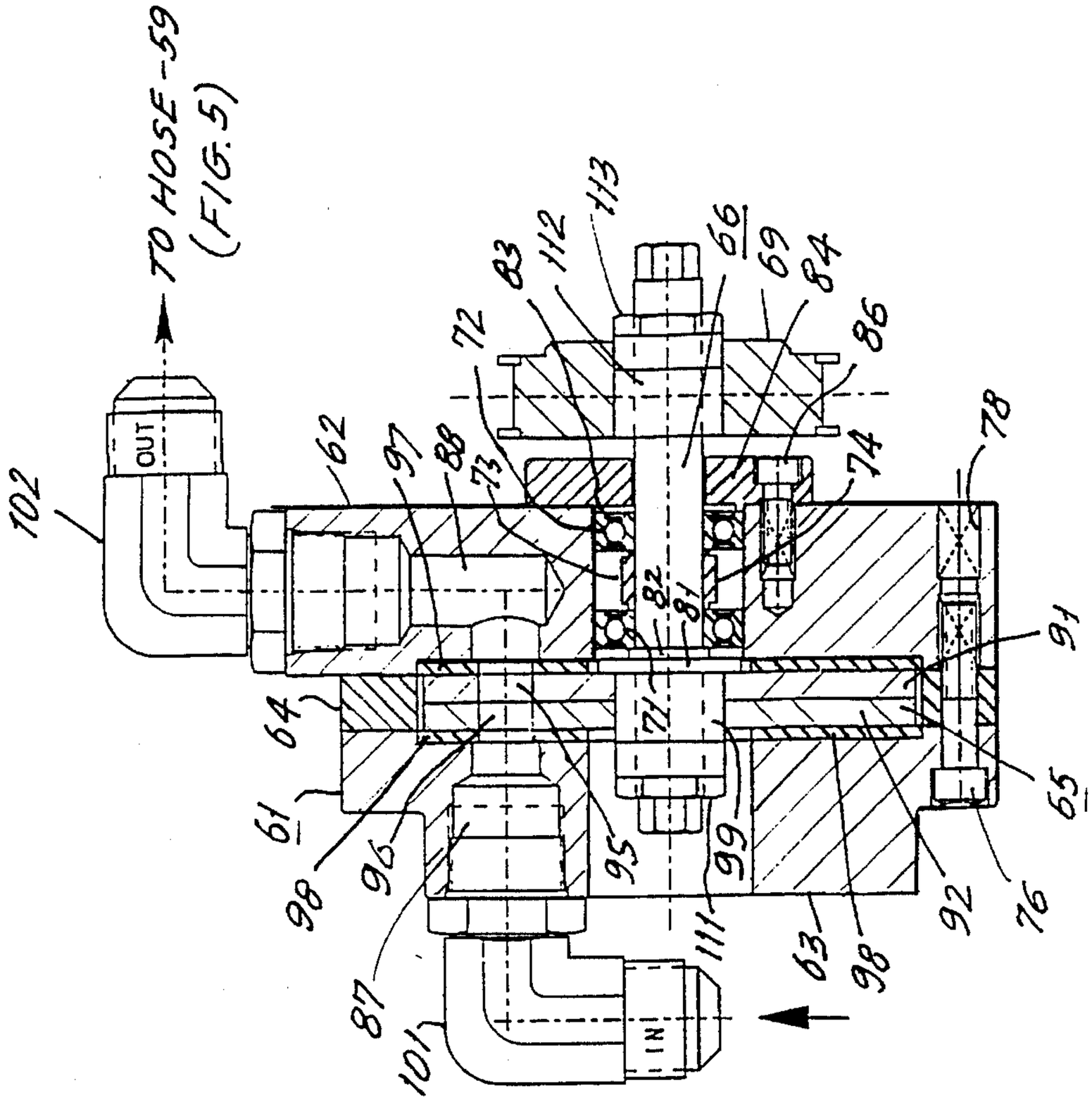

TO HOSE -59
(FIG. 5)
OUT
IN
102
62
97
88
73
72
83
112
113
66
69
84
86
74
78
82
81
91
64
71
65
61
98
96
95
99
92
76
87
111
63
98
101

Fig. 8.

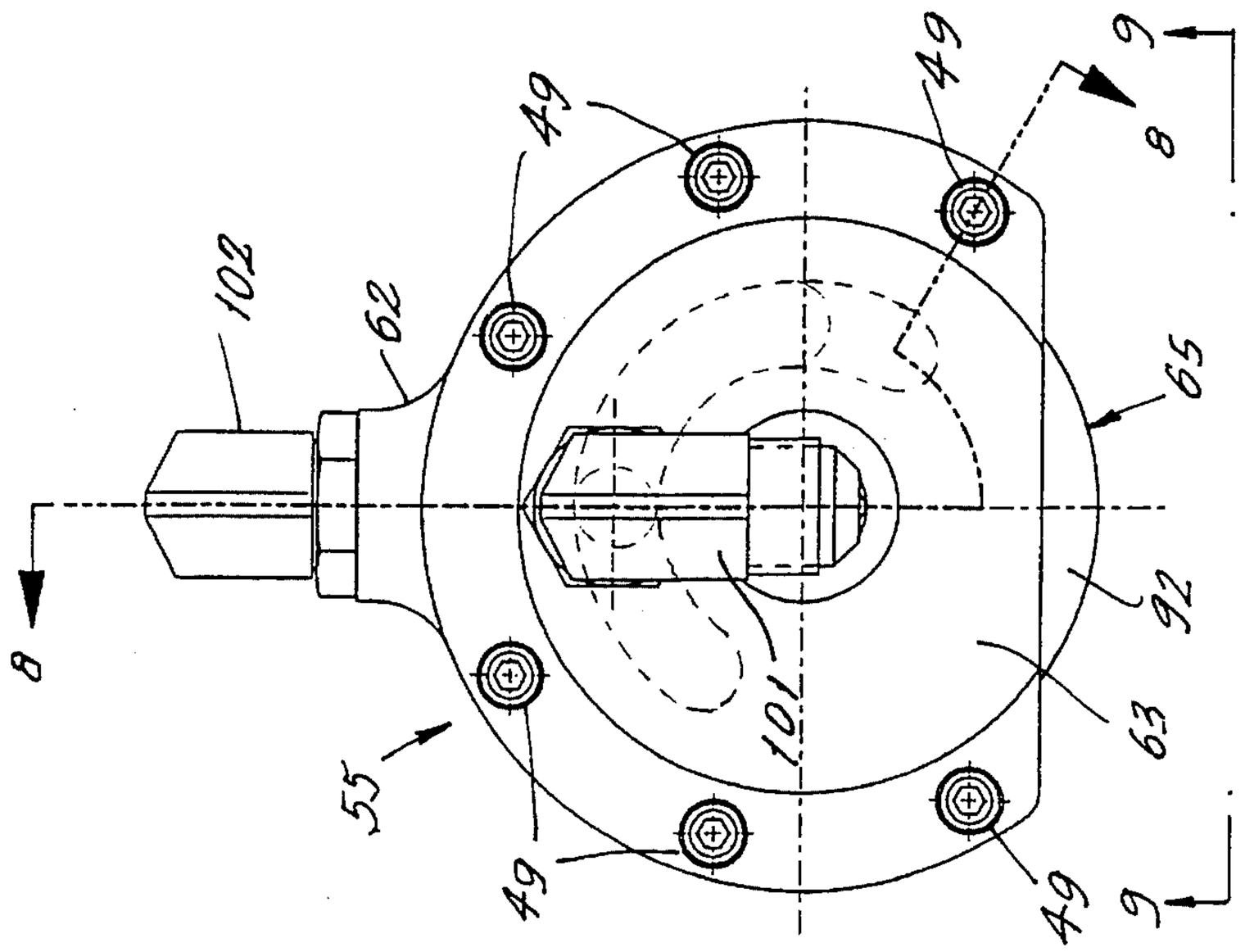

49
49
9
8
102
62
65
92
8
55
101
63
49
49
9

Fig. 7.

ROTARY VALVE CONTROLLED APPARATUS FOR STRIPPING CANS FROM BODYMAKING RAM

BACKGROUND OF THE INVENTION

This invention relates generally to can bodymaking equipment and in particular relates to stripping of newly formed can bodies from the ram that drives the can forming blank through the forming dies.

In the art of bodymaking apparatus for transforming blanks in the form of relatively short metal cups into elongated bodies for two piece cans, the bodies are stripped from the ram by mechanical devices that engage the edge at the open end of the body and/or by utilizing compressed air that enters the can body through one or more outlets at the downstream end of the ram. Mechanical strippers by themselves have been found to be unreliable, especially at high production speeds. Problems have also arisen at high production speeds when application of compressed air for stripping is under the control of valves that are mounted in the ram at its downstream end to be actuated by sensing that formation of the can body base profile has been completed. The prior art has also controlled application of compressed air for stripping by utilizing solenoid actuated valves that are mounted on the machine frame in a stationary position. Because solenoid valves are relatively slow to recycle, it is difficult to meet high cycle rate requirements. Air-line supply contaminates add to this problem. While solenoid valves can be shielded from much machine vibration, the total effect of slow recycling and contaminates is that solenoid valve operation becomes erratic at high cycle rates, making it difficult to maintain, adjust and/or control coordination between the position of the ram and the application of compressed air for stripping.

Examples of can body strippers are disclosed in U.S. Pat. No. 3,524,338 issued Aug. 18, 1970 to J. S. Bozek for A Stripping Punch; U.S. Pat. No. 3,572,271 issued Mar. 23, 1971 to E. C. Fraze for Fabrication Of Can Bodies With Integral Bottom Walls; U.S. Pat. No. 3,771,344 issued Nov. 13, 1973 to G. W. Wright for Apparatus For Stripping Container Bodies From Metal Working Punches; and U.S. Pat. No. 5,056,350 issued Oct. 15, 1991 to B. A. Moen, W. R. Williams, B. E. Johansson and L. W. Mayer for Apparatus And Method For Stripping A Workpiece From Supporting Device.

SUMMARY OF THE INVENTION

To overcome the foregoing problems of the prior art, compressed air stripping of cam bodies from the ram of the bodymaker is controlled by utilizing a mechanically operated rotary control valve having a rotor that rotates continuously in a single direction and within each rotation of the rotor its speed is essentially uniform. This is accomplished by driving the control valve rotor from the same shaft that provides the input power to the mechanism that reciprocates the ram. The rotor provides a passageway between input and output ports of the control valve during a selected portion of each rotor revolution and when this connection is made the control valve is said to be open. When open, the valve provides a passage through which compressed air is applied through the interior of the ram into the interior of the newly formed can body, whereby the latter is stripped from the ram by being prevented from moving rearward with the ram as the latter moves in its return stroke.

As will hereinafter be seen, the rotor of the control valve is constructed of a pair of disks that are assembled on the rotating valve shaft. These disks are angularly adjustable relative to one another to adjust the period during which the control valve is open. The angular position of the disk assembly is adjustable relative to the timing pulley through which the valve shaft is driven to adjust phasing between the control valve and the ram of the bodymaker.

Accordingly, a primary object of the instant invention is to provide a can bodymaker having improved compressed air stripping apparatus for removing can bodies from the bodymaker ram.

Another object is to provide a compressed air stripping device of this type that is reliable at high production speed, requires reduced maintenance and has a long operating life.

Still another object is to provide a compressed air stripping device of this type that is readily adjustable to control the portion of each cycle during which compressed air is applied for stripping of a can body.

A further object is to provide a compressed air stripping device of this type constructed so that adjustment of phasing between valve operation and ram position is facilitated.

Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective of a can bodymaker that includes body stripping apparatus constructed in accordance with teachings of the instant invention.

FIGS. **2** and **3** are schematics of the bodymaker of FIG. **1** looking in the direction of arrows **2—2** in FIG. **1**. In FIG. **2** the ram of the bodymaker is in its most rearward position after having completed its return stroke and in FIG. **3** the ram is in its most forward position after having completed its working stroke.

FIG. **4** is a fragmentary side elevation of the mechanism for reciprocating the ram.

FIG. **5** is a fragmentary partially sectioned side elevation of the ram and its connection to the driving mechanism.

FIG. **6** is a rear elevation showing the mounting of the continuously rotating can stripping control valve.

FIG. **7** is a front elevation of the can stripping control valve.

FIG. **8** is a cross-section taken through line **8—8** in FIG. **7** looking in the direction of arrows **8—8**.

FIG. **9** is a side elevation of the control valve looking in the direction of arrows **9—9** in FIG. **7**.

FIG. **10** is a front elevation of the phase disk of the rotor for the control valve.

FIG. **11** is a front elevation of the index disk for the rotor of the control valve.

DETAILED DESCRIPTION OF THE INVENTION

Now referring to the Figures and more particularly to FIGS. **1** through **5** which, for the most part, are also found in U.S. Pat. No. 4,173,138 which issued Nov. 6, 1979 to R. M. Main and E. Paramonoff for a Can Bodymaker Having Improved Ram Support and Drive. The teachings of U.S. Pat. No. 4,173,138 are incorporated herein by reference.

In a manner known to the art of making metal beverage containers, can bodymaker **15** transforms blanks in the form of shallow metal cups **16** (FIG. **2**) delivered by infeed device **17** into elongated can bodies **18** (FIG. **3**) which drop downwardly and are received by outfeed device **19**. This is accomplished by utilizing reciprocating drive mechanism **20** to move horizontally disposed hollow ram **25** longitudinally forward in a working stroke from its rearmost position of FIG. **2** to its most forward position of FIG. **3**, at which point movement of ram **25** is reversed and ram **25** moves in a return stroke to its most rearward position of FIG. **2**. During its forward working stroke, ram **25** drives cup **16** through ring die assembly **22** which reduces the diameter and sidewall thickness of blank **16** while elongating same to form can body **18**. During the forward and rearward movement, ram **25** is supported by spaced stationary bearing sleeves **23** and **24**.

Driving mechanism **20** is connected to the rear of ram **25** by bearing slide assembly **35** (FIG. **5**). The latter is pivotally connected to the front end of drive rod **36** whose rear end is pivotally connected to the free upper end of drive arm **37**, and the lower end of drive arm **37** is fixed to the machine frame at pivot center **38**, so as to oscillate thereabout. Arm **37** is driven by transfer arm **39**, one end of which is connected by pivot **41** to crank arm **43** and the other end of which is pivotally connected at **42** to drive arm **37** at a point intermediate the ends thereof. Pivot **41** is at the free end of crank arm **43** which extends radially from main shaft **44** and is keyed thereto for rotation thereby. Bull gear **40** is also keyed to main shaft **44** for rotation therewith, and is in mesh with pinion **46** that is keyed to drive shaft **47** which is driven by electric drive motor **48** through variable speed drive **49**.

To assure that can body **18** does not move rearward with ram **25**, compressed air is applied to the interior of ram **25** through appropriate passageways of connecting means **35** at the rear of ram **25** and this compressed air exits through front opening **52** (FIG. **5**) of ram **25** to the inside of can body **18** so as to strip same from the front end of ram **25**. For this purpose connecting means **35** is provided with a passage having connected axial **56** and transverse **57** sections, with the latter having short pipe **58** extending therefrom. Flexible hose **59** extending from pipe **58** is operatively connected to can stripping control valve **55** which shall now be described with particular reference to FIGS. **6** through **11**.

Valve **55** includes housing **61** consisting of rear section **62**, front section **63**, and spacer **64** interposed between sections **62** and **63** to provide a cavity wherein most of rotor **65** is disposed. Main elements **62–64** of housing **61** are secured together by six bolts **76** that extend through clearance apertures adjacent the periphery of elements **63** and **64**, and are received by threaded apertures entered at the front of rear housing element **62**. Threaded apertures **78** enterable at the rear of rear housing element **62** are adapted to receive mounting bolts **77**. There are six apertures **78** and, as seen in FIG. **6**, for securing valve **55** to mounting bracket **75** only three bolts **77** are required. Two additional bolts **79** secure bracket **75** to fixed frame **80** that also supports ram **25** and the other operating elements of bodymaker **15**.

Valve shaft **66** rotatably supports rotor **65**, and is driven in synchronism with reciprocation of ram **25** by timing belt **67**. That is, for each cycle or revolution of shaft **66**, ram **25** is driven through one complete cycle consisting of a forward working stroke and a rearward return stroke. Timing belt **67** is driven by pulley **63** and drives pulley **69**. Pulley **63** is keyed to main shaft **44** and pulley **69** is keyed to valve shaft **66**, being disposed behind rear housing section **62**. Shaft **66** extends through and is supported by bearing sections **71, 72** that are separated by ring spacer **73**.

Bearing sections **71**, **72** (FIG. **8**) are closely fitted in aperture **74** that extends through rear housing section **62**. Integrally formed on shaft **66** and protruding radially therefrom are wide shoulder **81** and narrow shoulder **82**. The latter extends into aperture **74** through its front end and engages bearing section **71**. Bearing section **72** is engaged by ring **83** that is disposed on the front surface of cap **84** and extends axially therefrom. Cap **84** is provided with a central aperture through which shaft **66** extends and is disposed between rear housing section **62** and pulley **69**, being held against the rear surface of housing section **62** by a plurality of bolts **86**.

Control valve **55** is also provided with inlet port **87** formed by a passage through front housing section **63**, which passage is parallel to the rotational axis of shaft **66**. Valve **55** is also provided with outlet port **88** in the form of an L-shaped passage that extends through rear housing section **62** from its forward surface to its edge. The rear or exit end of inlet port **87** is axially aligned with the inlet end of exit port **88**.

Rotor **65** is an assembly consisting of phase disk **91** (FIG. **10**) and index disk **92** (FIG. **11**). As seen in FIG. **8**, the front surface of disk **91** abuts the rear surface of disk **92**. The respective rotor forming disks **91**, **92** are provided with central circular apertures **93**, **94** and arcuate apertures **95**, **96**. The latter are formed about the center of the respective disks **91**, **92** and extend for 120°. Disks **91**, **92** are of the same diameter, central apertures **93**, **94** are of the same diameter, and arcuate apertures **95**, **96** are of the same size (both length and width) and are located the same distance from the disk centers. Thin friction plates **97**, **98** are secured within shallow recesses of the respective housing sections **62**, **63**. The front face of friction plate **97** is adjacent the rear face of phase disk **91** and the rear face of friction plate **98** is adjacent the front face of index disk **92**. Friction plates **97**, **98** are provided with apertures which are in alignment with the inlet and outlet ports **87**, **88** of valve **55**, and are also provided with apertures through which shaft **66** extends.

Expandable element **99** disposed within central aperture **93**, **94** of rotor **65** and surrounding shaft **66**, constitutes an adjustable coupling that keys rotor **65** to shaft **66** for rotation by the latter. Contraction of coupling **99** permits the relative angular positions between rotor disks **91**, **92** to be adjusted. In a manner well known to the art coupling **99** is expanded by tightening nut **111** that is mounted on shaft **66** adjacent the front end thereof. This tightening of nut **111** squeezes coupling **99** against shoulder **81** causing coupling **99** to expand and firmly engage both shaft **66** and rotor **65**. The centers of arcuate apertures **95**, **96** are the same distance from the center of shaft **66** as are the outlet end of inlet port **87** and the inlet end of outlet port **88**, so that for selected portions during each revolution of rotor **65** arcuate aperture **95** communicates with outlet port **88** and arcuate aperture **96** communicates with inlet port **87**.

Elbow fitting **101** is secured to front housing section **63** and is used to connect inlet port **87** to a source of compressed air, while elbow fitting **102** is secured to rear housing section **62** for connecting outlet port **88** to flexible hose **59** which is connected to the interior of ram **25**.

Valve **55** is said to be open when there is communication between inlet and outlet ports **87**, **88**. For 240° of rotation for rotor **65** inlet port **87** is closed by rotor disk **92** in that the exit of inlet port **87** and arcuate aperture **96** are out of alignment. Similarly, for 240° of rotation for rotor **65** outlet port **88** is closed in that the inlet thereto is out of alignment with arcuate aperture **95** of phase disk **91**. In FIG. **8** control valve

55 is shown open in that arcuate aperture **96** is aligned with the exit end of inlet port **87** and arcuate aperture **95** is aligned with the entrance end of exit port **88**, and at the same time there is at least partial overlapping between arcuate apertures **95**, **96**.

The interval during each revolution of rotor **65** during which control **55** is open depends upon the relative angular positions between rotor disks **91**, **92**. This condition is indicated by the position of index mark **103** on the edge of index disk **92** relative to the angle indicating indicia along the edge of phase disk **91**. As seen in FIGS. **6**, **7**, **10** and **11**, a peripheral portion of rotor **65** extends outside of housing **61**. This facilitates adjusting the relative angular position between rotor disks **91**, **92**. By positioning index mark **103** outside of housing **61** (FIG. **9**), the indicia on phase disk **91** relative to index mark **103** is observable.

While body maker **15** is operating, during each revolution of rotor **65** the position of ram **25** when control valve **55** first opens is, preferably, just as ram **25** reaches the end of its working stroke (FIG. **3**) and is about to reverse direction to move rearward in its return stroke. With control valve **55** open, compressed air fed thereto is applied through the hollow interior of ram **25**, and appears at front exit **52** thereof to assure that the newly produced can body **18** does not move rearward together with ram **25**. Instead, can body **18** drops into outlet **19**. The phasing between control valve rotor **65** and ram **25** is adjusted by setting the angular position of rotor **65** relative to that of pulley **69** on valve shaft **66**. This may be accomplished by operating nut **113** at the rear of shaft **66** to relax coupling ring **112** that keys pulley **69** to shaft **66**. With coupling ring **112** relaxed shaft **66** and rotor elements **91**, **92** may be rotated relative to pulley **69**.

Although the present invention has been described in relation to particular embodiments thereof, many other variations and modifications and other uses will become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

What is claimed is:

1. A bodymaker for transforming metal cups into elongated can bodies, said bodymaker including:

an elongated ram supported for horizontal longitudinal movement along a straight fixed path;

drive means for moving said ram forward along said path in a working stroke followed by rearward movement of said ram along said path in a return stroke, said drive means including a continuously rotating main shaft;

a die set for transforming said cups into said can bodies as said cups are driven through said die set by said ram during said working stroke;

apparatus for applying compressed air through said ram into said can bodies to strip said can bodies from said ram while the latter begins said return stroke;

said apparatus including a rotary valve for controlling application of said compressed air through said ram into said can bodies;

said rotary valve including a valve shaft and a rotor mounted on said valve shaft for rotation therewith;

said valve shaft being rotated continuously at uniform speed within each revolution thereof; and

said valve shaft being operatively connected with said main shaft for operation of said valve in coordination with movement of said ram;

for each revolution of said rotor, said ram operating through a cycle comprising said working and return strokes;

said valve also including an inlet port and an outlet port;

said rotor including a passage which, during a predetermined portion of each revolution for said rotor, is operatively positioned to connect said inlet port to said outlet port whereby compressed air applied to said inlet port appears at said outlet port;

said rotor including first and second elements mounted on said valve shaft for relative adjusting movement between said first and second element to adjust duration of said predetermined portion;

said rotor being adjustably positionable relative to said main shaft to adjust phasing between rotation of said rotor and movement of said ram by setting a location for said ram along said path at which compressed air is initially applied through said valve to said ram during each cycle thereof to strip a can body from said ram.

2. A bodymaker as defined in claim **1** in which each of said first and second elements is plate-like;

said elements being in parallel planes that are adjacent to each other and are perpendicular to said valve shaft;

said passage being defined by first and second apertures that extend through said first and second elements, respectively.

3. A bodymaker as defined in claim **2** in which each of said first and second apertures is shaped as an arc segment that is formed about said valve shaft as a center; and

said apertures are operatively positioned to at least partially overlap one another.

4. A bodymaker as defined in claim **3** in which said first and second elements are constituted by respective first and second disks;

said valve shaft defining a rotational axis that extends through said disks at their respective centers; and

said arc segments being equally spaced from said rotational axis.

5. A bodymaker as defined in claim **4** in which said rotary valve also includes a housing having said inlet and outlet ports;

said valve shaft being rotatably supported on said housing; and

said housing enclosing a majority of said rotor with edge portions of said rotor extending outside of said housing whereby said first and second elements are accessible from outside of said housing for relative adjusting movement between said elements to adjust said duration of said predetermined portion of each revolution for said rotor.

6. A bodymaker as defined in claim **1** also including a stationary frame on which said ram is supported for said horizontal longitudinal movement;

said rotary valve also including a housing on which said shaft is rotatably supported;

said housing being fixedly secured on said frame;

a timing belt interposed between said main shaft and said valve shaft and through which power is transmitted to drive said valve shaft and coordinate operation between said valve shaft and said ram.

7. A rotary valve for controlling duration for application of compressed air to a mechanical machine section which is operated continuously and cyclically by a drive means that also provides power to drive a rotor of said valve continuously at uniform speed throughout a valve cycle that is equal in time to a cycle of said machine section, said valve cycle being equal in time to a complete revolution of said rotor, said rotary valve also including:

a shaft rotated continuously by said drive means and a rotor mounted on said shaft for rotation therewith;

an inlet port and an outlet port;

said rotor including a passage which, during a predetermined portion of each revolution for said rotor, is operatively positioned to connect said inlet port to said outlet port whereby compressed air applied to said inlet port appears at said outlet port;

said rotor including first and second elements mounted on said shaft for relative adjusting movement between said first and second elements to adjust duration of said predetermined portion.

8. A rotary valve as defined in claim **7** in which each of said first and second elements is plate-like;

said elements being in parallel planes that are adjacent to each other and are perpendicular to said shaft;

said passage being defined by first and second apertures that extend through said first and second elements, respectively.

9. A rotary valve as defined in claim **8** in which each of said first and second apertures is shaped as an arc segment that is formed about said shaft as a center; and

said apertures are operatively positioned to at least partially overlap one another.

10. A rotary valve as defined in claim **9** in which said first and second elements are constituted by respective first and second disks;

said shaft defining a rotational axis that extends through said disks at their respective centers; and

said arc segments being equally spaced from said rotational axis.

11. A rotary valve as defined in claim **10** also including a housing having said inlet and outlet ports;

said shaft being rotatably supported on said housing; and

said housing enclosing a majority of said rotor, with edge portions of said rotor extending outside of said housing whereby said first and second elements are accessible

from outside of said housing for relative adjusting movement between said elements to adjust said duration of said predetermined portion of each revolution for said rotor.

12. A rotary valve as defined in claim **10** in which said disks have essentially equal diameters; and said arc segments are essentially the same in size and shape.

13. A rotary valve as defined in claim **10** in which said rotor is adjustably positioned relative to said drive means to adjust phasing between said rotor and said machine section by setting a point during each cycle of operation for said machine section at which compressed air is initially applied thereto through said rotary valve.

14. A rotary valve:

including stationary inlet and outlet ports, a rotor interposed between said ports, a drive shaft on which said rotor is mounted and through which power is applied to rotate said rotor continuously;

said rotor comprising first and second elements mounted face-to-face, each of said elements having an aperture segment therethrough, with overlapping portions of said aperture segments cooperating to provide a passage connecting said ports together during a portion of each revolution of said rotor;

said elements being adjustable relative to one another by pivoting at least one of said elements relative to said shaft to adjust overlapping of said aperture segments and thereby establish duration for said portion of each revolution of said rotor;

said rotor being pivotally adjustable relative to said drive shaft to adjust phasing between rotation of said rotor and a device that is provided with compressed air that flows through said rotary valve.

* * * * *